Methyl bromide alternatives

Vol. 3, No. 2 April 1997

USDA

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Inside This Issue

The New Food Quality Protection Act and Cal/EPA Reactions

A complex piece of legislation, the new Food Quality Protection Act (FQPA) reforms the nation's food safety laws. Signed into law by President Clinton on August 3, 1996, the act amends the two major laws involving pesticides: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). FQPA revises the FFDCA so that the 1958 Delaney Clause no longer affects pesticides. The Delaney Clause established a zero cancer risk standard for pesticide residues on some processed foods as compared to a negligible risk standard for raw commodities.

FQPA is important to the methyl bromide issue because many of the potential alternatives to be considered will fall under its provisions.

Highlights of the new law include the following:

Amends the Federal Food, Drug, and Cosmetic Act and Creates Single Safety Standard
Replaces the Delaney Clause—thereby abolishing the zero cancer risk standard for pesticide residues in some processed foods—with a single "safe" standard of a reasonable certainty of no harm to consumers for pesticide residues in raw and processed foods.

Limits Consideration of Benefits
When setting pesticide tolerances using benefits considerations, builds in a safety factor for "nonthreshold" health risks. Strictly limits exemptions from the established standards to ensure a stable food supply and mandates that the public be informed when crop emergencies require that the standard be relaxed.

Provides Protection for Infants and Children
Requires explicitly that pesticide residues be safe for infants and children and includes an additional safety factor of 10-fold, if necessary, to allow for uncertainty in data collected on children's diets. Also takes into account children's special sensitivity to pesticides.

Sets National Uniformity
Prohibits state and local governments from setting pesticide tolerances more rigid than those established by the U.S. Environmental Protection Agency, unless states petition EPA for exception.

Gives Consumers Right To Know
Requires EPA to prepare for produce retailers a brochure discussing the risks and benefits of pesticides, how to avoid risks including recommending substitute foods, and identifying foods that have tolerances for pesticide residues that were granted under the benefits provisions of FQPA. Recognizes states' rights to require warning or labels on food treated with pesticides, such as California's Proposition 65.

This newsletter provides information on research for methyl bromide alternatives from USDA, universities, and industry.

Address technical questions to Kenneth W. Vick, USDA, ARS, National Program Staff, Bldg. 005, Room 237, BARC-West, 10300 Baltimore Ave. Beltsville, MD 20705. Phone (301) 504-5321, Fax (301) 504-5987.

Address suggestions and requests to be added to the mailing list to Doris Stanley, USDA, ARS, Information Staff, 6303 Ivy Lane, Room 444, Greenbelt, MD 20770. Phone (301) 893-6727, Fax (301) 705-9834.

Requires Reevaluation of Tolerances
Requires all existing pesticide residue tolerances to be reviewed within 10 years to ensure they meet the new health-based standard.

Changes the Federal Insecticide, Fungicide and Rodenticide Act

- *Pesticide Reregistration Program*: Reauthorizes and increases user fees from $14 million to $16 million each year; the fees cover review of older pesticides to ensure they meet current standards. Makes reassessment of tolerances part of reregistration.

- *Pesticide Registration Renewal*: Requires EPA periodic review of pesticide registrations to establish a 15-year cycle to ensure that all pesticides meet new safety standards.

- *Registration of Reduced-Risk Pesticides*: Provides for quick review of reduced-risk pesticides to enable them to reach the market sooner to replace older, potentially more risky chemicals.

- *Minor-Use Pesticides*: Establishes minor-use programs in EPA and USDA to coordinate use issues and policy and provides a revolving grant fund to develop data necessary to register minor-use pesticides.

Also encourages minor-use registrations through extensions for submitting pesticide residue data and exclusive use of data, flexibility to waive certain data requirements, and requiring EPA to expedite review of minor use applications.

Cal/EPA Reactions to FQPA

While provisions of the new Food Quality Protection Act addressing minor crops will have some positive impacts on California agriculture, the act contains problematic features that may reduce the availability of important pest control tools, according to James W. Wells, director of California's Department of Pesticide Regulation, Cal/EPA. Methyl bromide and its alternatives may be affected by how some of the act's provisions are implemented.

Wells cautions that the tolerance reassessment timeframes are exceedingly short, given the complexity of the new safety standard. Depending on how EPA uses default assumptions in implementing the new safe standard for tolerances under the new act, growers could be left with fewer products to address pest problems, which could increase the chances of pests' developing resistance to the remaining compounds.

"There could also be a loss of materials critical to IPM systems, resulting in a return to older, more chemically intensive pest control strategies. Loss of key pesticides could also result in increased usage of remaining compounds with potentially harmful environmental and health consequences," he notes.

An example of this would be that loss of insecticides effective at low rates of application may lead to more frequent use of other insecticides or use at higher rates, causing the potential for greater worker exposure and adverse environmental consequences such as runoff into surface waters or air pollution. Wells says that California would like to see EPA move cautiously and consider the potential impacts of the use of default assumptions on pest management systems.

Under the new act, the requirement for tolerances for emergency exemptions under Section 18 of FIFRA could also be significant for California. Section 18 allows EPA to exempt certain uses of a pesticide from the requirements of the act. These emergency exemptions address pest emergencies that arise when no suitable pesticides are registered for use on that pest. Since California is unique in its diversity, pest pressures, climatic conditions, and lack of sufficient pest management techniques for all minor uses, these Section 18 emergency exemptions are vital to the health of the state's agriculture.

The Section 18 exemption process is intended to be an expedited process. Exemptions are short-lived and must be reapproved annually. Tolerances and, therefore, exposures to Section 18 chemicals are time-limited until the chemical is registered. Using the same process to establish tolerances for exemptions and full registrations seems to contradict the emergency nature of the process.

"The way EPA implements this provision is critical for growers of minor crops to continue to respond to emergency situations that arise in California," Wells says. "We know that EPA is working hard to comply with the new act in a timely fashion, and we're working closely with them."

FQPA is expected to have some positive impacts on California agriculture. "There are incentives for minor crop uses," says Wells. "Since most crops grown in California are fruits, vegetables and nuts, we're a 'minor crop' state. We produce more than 250 raw agricultural commodities. But they don't represent major markets for pesticides which were developed primarily for use on corn, soybeans, wheat, rice, and cotton, which are the nation's major crops."

Wells says that in the past, pesticide registrants have sometimes made the economic decision not to produce costly data to enter or remain in the minor crop marketplace. "The incentives and program direction provided by FQPA should begin to address the needs of minor crop growers for viable pest management tools, especially if Congress appropriates the authorized funds for the revolving grants program to be administered by USDA," he explains.

According to Wells, the reduced-risk provisions of the Act will give EPA the impetus to further promote development of reduced-risk pesticides. These provisions will allow EPA to focus registration priorities on implementing integrated pest management (IPM) nationwide.

"California farmers are well positioned to expand IPM practices and adopt reduced-risk pest management practices when new products become available," he says.

Using Tillam on Florida Tomatoes

As time ticks away, steadily decreasing the number of crop seasons left before 2001, the search for alternatives to methyl bromide intensifies. Each year, Florida growers produce fresh-market tomatoes worth about $450 million on 50,000 acres, relying almost exclusively on methyl bromide to rid their soil of pests and diseases. Researchers at the University of Florida have stepped up their efforts to find pest control strategies that are as effective as methyl bromide, yet environmentally sound and economically feasible for growers.

"Controlling weeds, especially purple nutsedge, is one of the most important limitations of fumigant alternatives for Florida growers who now plant tomatoes on raised, polyethylene mulched beds of methyl bromide-treated soil," explains James P. Gilreath. A weed scientist with the University of Florida's Gulf Coast Research & Education Center in Bradenton, Gilreath and colleagues have been experimenting with the herbicide Tillam (or pebulate). Although Tillam is an old product, commercial tomato growers in Florida have little experience with it because methyl bromide gives such good weed control.

Aided by University of Florida researchers John P. Jones and Joseph W. Noling, Gilreath has been working with Tillam since 1994. Research collaborators include USDA's Agricultural Research Service, the Florida Fruit and Vegetable Association, the Florida Tomato Committee and the U.S. Environmental Protection Agency.

"Although we haven't found anything as effective as methyl bromide, we got good results when we used Tillam to control the nutsedge and chloropicrin for soilborne diseases," Gilreath reports. "We found that Tillam controls nutsedge in both mulched and nonmulched tomatoes. However, applying a herbicide can require additional equipment and more time in field and bed preparation."

Also, how the Tillam is applied is vitally important. "The herbicide must be thoroughly incorporated in the soil within minutes after it is applied. Using bedding disks does not provide adequate mixing of the herbicide with the soil and could result in crop injury," he states.

Although the Tillam label specifies double incorporation by disking at right angles, research has determined that unidirectional incorporation by disk, field cultivator, or rototiller followed by preparation of a raised bed gives comparable results. Gilreath says that thoroughly mixing Tillam into the soil will improve its effectiveness and reduce its phytotoxicity. Also, the soil should be moist and free of clods and large pieces of plant debris. A fumigant should then be applied as soon as possible after incorporating Tillam.

It is generally recommended that power-driven cultivation equipment or a tandem disk be used to apply Tillam preplant, followed by a spike-tooth harrow, with disking performed twice at right angles. "In experiments with mulched tomatoes, we got good nutsedge control by using a rototiller to incorporate Tillam, then injecting Telone C-17 (1,3-dichloropropene plus 17 percent chloropicrin). In fact, this treatment worked as well as methyl bromide applied alone in many of our experiments," Gilreath reports.

But most tomato growers don't have rototillers to incorporate Tillam into the soil. Although bed preparation equipment that includes a rototiller in the mouth of the bedder is available, the rototiller requires more horsepower and, thus, a larger tractor than that needed for a typical bedder. Gilreath says that readily available cultivation equipment typically consists of a disk and a field cultivator, or an S-tine harrow. This harrow has small sweeps and rolling cages on the rear for breaking up soil crusts and trash. Numerous field ditches for irrigation and drainage make right angle disking virtually impossible.

Given time constraints, especially between the fall and spring seasons in west central Florida, land preparation must be done quickly with a minimum amount of equipment, according to Gilreath. "Viability of any alternative fumigant would depend on an easy, or minimal, change in growers' equipment and operations," he says.

Therefore, in the spring of 1996, he and colleagues selected a test site in Bradenton that was heavily infested with purple nutsedge and incorporated Tillam into the soil with one pass of a disk or field cultivator in one direction and prepared the beds with a typical bedder. They compared this plot to one where they used a tractor-powered rototiller prior to bed preparation and added applications of Telone C-17.

In fine, sandy soil with 0.78 percent organic matter and 7.1 pH, they applied Tillam at 4 pounds of active ingredient per acre, and incorporated the herbicide 6 inches deep with a 5-ft disk, a 6-ft field cultivator and a tractor-powered rototiller immediately after application to the soil surface. Telone C-17 was applied at 35 gallons per acre.

"We found no difference in nutsedge control in plots that were tilled with a rototiller, disk or field cultivator. When we added a fumigant, nutsedge control was better initially, but by late season there was no difference in the amount of nutsedge growing in fumigated and nonfumigated plots," Gilreath says. "Plant vigor and fruit production were greater in fumigated plots, but about the same in plots

where Tillam had been incorporated by rototiller, disk or field cultivator."

Trials on commercial tomato farms have demonstrated good weed control when Tillam was applied and incorporated with a S-tine harrow, followed by bed formation with bedding disks or disk hillers and a bed press. However, nutsedge was not a problem weed on these farms. Gilreath says that the acid test is under way this spring on a commercial tomato farm that has a history of nutsedge problems. "We hope results there will reflect our research findings," he says.

Growers are concerned with a number of factors related to fumigant alternatives to methyl bromide. Besides efficacy, the ease with which a new procedure can be adapted is significantly important, as is the cost of equipment replacement and any inherent changes. Different fumigants have different price tags, but all of the currently available alternatives require the use of a herbicide like Tillam. At approximately $31.25 per acre, the cost for Tillam isn't restrictive. Although proper application increases the cost factor due to equipment and manpower requirements, the cost is still nominal.

Gilreath says that the package treatment of Telone C-17 and Tillam costs about the same as methyl bromide on an equivalent rate basis, but it costs more to apply these materials, and none of the alternatives are as foolproof as methyl bromide.

Research has shown that Tillam works as well with chloropicrin and other fumigants as it does with Telone C-17. However, Telone C-17 provides more broad-spectrum pest control than the other alternatives.

"Whatever alternative we choose most likely will have to be combined with a herbicide, though few herbicides are approved for use on other vegetables. We really don't know what growers of cucumbers, watermelons, peppers, eggplants and a host of other crops will do to control nutsedge and other troublesome weeds," says Gilreath.

One thing is clear, the future of soil-borne pest control without methyl bromide will be one of a more prescriptive nature. The grower will have to know and target pests in order to select what is best for individual situations.

Says Gilreath, "We are entering the age of integrated pest management in soil fumigation. It will be a challenge, but farmers face those every day. Hopefully, research will lead the way."

A New Patented Process Contains, Recaptures, and Recycles Methyl Bromide

As the new millennium approaches, so does the proposed methyl bromide phaseout. The scientific community is delving deep to find possible alternatives to methyl bromide. But a single solution may not exist.

A Canadian company, Knowzone Solutions, Inc., Etobicoke, Ontario, believes containing, recapturing and recycling methyl bromide offers the potential to maintain its beneficial uses, yet dramatically reduce ozone-damaging emissions into the atmosphere. Praxair Canada, Inc., granted Knowzone Solutions, Inc., the worldwide right to the patented Bromosorb™ process that contains, recaptures and recycles methyl bromide.

"The Bromosorb™ process provides a unique opportunity to capture approximately 95 percent of the methyl bromide currently being released to the atmosphere," says Errick Willis, president of Knowzone Solutions.

In chamber or space fumigation, most of the methyl bromide is vented into the atmosphere. Soil fumigation uses a predetermined amount of methyl bromide in a designated space for a specific residency period. Approximately 50 percent of the initial amount of methyl bromide is absorbed and the rest is vented to the atmosphere at the end of this period.

"Our tests on cherries and grapes in chamber fumigation have shown approximately 20 percent of the methyl bromide is either consumed or absorbed by the fruit or its containers, with the balance vented to the atmosphere. The amount of methyl bromide absorbed varies, depending on the commodity and how it is fumigated," says Willis.

As part of a joint collaboration to help the Chilean horticultural industry meet environmental obligations to reduce the emissions of ozone-depleting substances, Environment Canada is helping build a methyl bromide recovery plant. The plant has been installed on the premises of David del Curto SA in Kalinka, Chile, where grapes are fumigated.

As part of the project, Knowzone Solutions developed and supervised a testing program to ensure the plant met its intended performance specifications. Don Smith, a leading expert on recycling technology, observed the testing and provided a report for the Executive Committee of the Multilateral Fund. (Copies of the report are available from Errick Willis, Ph: 416-622-7920 or fax: 416-622-6723.)

The stainless steel methyl bromide recovery plant is a self-contained unit that sits on a concrete base adjacent to the fumigation chamber. It is connected by PVC ducts to one of the fumigation chambers. The solid-wall fumigation chamber is equipped with internal fans to ensure good fumigant mixing throughout the chamber.

Gas comes into the recovery plant from a low position on the back wall of the chamber, and the return line enters in the back near the top of the chamber, feeding into the internal circulation duct. Electrical controls

and instruments are contained in a cabinet. Since the fumigation chamber was designed to operate automatically, an operator is only needed to start the various phases of the operation and to monitor the gas concentration from time to time.

To initiate the fumigation process, the chamber is filled with fruit and methyl bromide is introduced into the chamber in accordance with label instructions. Once the commodity, soil, or space has been successfully fumigated, the methyl bromide-containing air is circulated through the Bromosorb™ unit where methyl bromide is adsorbed on Halozite®, a type of zeolite, and the exhaust is recycled through the fumigation area. This cooled-loop circulation continues until the concentration of methyl bromide at the inlet and outlet of the Bromosorb™ unit are equalized. At this point, the exhaust stream containing less than 50 parts per million (ppm) of methyl bromide is released into the atmosphere to make the area safe for personnel.

"For the second cycle, we load the fumigation chamber while the adsorbent is heating," Willis explains.

Zeolite holds more methyl bromide when it is cold and much less when warm. This different adsorptive capacity is used to release methyl bromide from the zeolite so it can be returned to the fumigation chamber. The adsorbent material rejects water, so its efficiency is unaffected in high humidity. It also has greater adsorptive capacity than carbon at low inlet concentrations, so it can operate efficiently in concentrations of less than 500 ppm.

The heating cycle continues until the temperature of the internally circulating gas that leaves the zeolite reaches 285 °F (140.6 °C). Next, the internal circulation fan is started and methyl bromide is introduced from the recovery plant into the chamber. The desorption of methyl bromide into the chamber from the hot zeolite begins. At this point, additional methyl bromide can be added. The zeolite is then cooled and fumigation continues.

Recaptured methyl bromide is stored on the Halozite® adsorbent until it is needed again. If the Bromosorb™ unit is permanently attached to a fumigation chamber, methyl bromide can be regenerated while the fumigation chamber is emptied of the treated commodity and refilled. Regeneration occurs in a closed loop with air heated to 285 °F, which releases the captured methyl bromide from the Halozite® adsorbent.

While in the closed loop, the recycled methyl bromide is tested to ensure its chemical composition meets the profile of virgin methyl bromide. The gas chromatograph also measures the concentration of methyl bromide so a precise calculation can be made of the additional amounts that must be added and to ensure that fumigation is consistent with the label instructions. Once the fumigation chamber has been reloaded with the commodity, the recycled methyl bromide is reintroduced to the chamber along with the specified amount of virgin methyl bromide, and the process repeats itself.

"We put the Chilean plant through seven complete cycles before the performance tests," says Willis. "In all, the plant underwent 12 cycles in a week. The testing program included five runs. We conducted four empty-chamber fumigation runs and we did one fumigation on a pallet of fruit to see if there were any gross changes in plant performance or methyl bromide purity. The fumigation chamber was left sealed until the end of run 3, then vented in preparation for run 4, where we used fruit. The chamber was also vented after runs 4 and 5.

"We concluded that one pallet of fruit in a 283m^3 chamber would not generate sufficient water vapor or volatile compounds to carry out definitive purity tests. We realized that testing methyl bromide residues on the fruit from only one pallet would not be realistic," says Willis.

The runs were performed at different times during the day and evening with a range of ambient temperatures. However, there was only a small difference in the rate of cooling. If the recovery plant is going to be used when ambient temperatures are much higher, attention should be given to the cooling rates and subsequent adsorption process to ensure the recycle process occurs within a 2-hour time limit. The performance specification called for a reduction in methyl bromide concentration in the chamber to 500 ppm within 45 minutes.

"There was a loss of approximately 1.6 Kg of methyl bromide in each run," notes Willis. "The most probable cause is leaks in the connection between the chamber and the recycling unit, because there was no pressure change during the heating and cooling stream. Circulating gases undergo a temperature change from approximately 100 °F during cooling to hotter than 300 °F during heating. A pressure increase of 0.35 bars (5.25 pounds per square inch) would have been expected from a closed system without zeolite.

"Another potential cause of the methyl bromide loss is a breakdown of the methyl bromide on the zeolite. There was no indication on the gas chromatograph of any other compound being formed and there were no odors detected that would be present with acids," says Willis.

These tests were carried out to achieve a minimal fumigant concentration of 48 g/m^3, which is equivalent to a 95.5-percent reduction. The adsorption time was extended to 60 minutes for all runs. In the fifth run, a concentration of 616 ppm (94 percent) was achieved. Adsorption performance results are very repeatable.

Further tests with the fumigation chamber loaded with fruit will be necessary. These tests are required to see if the fruit and its packaging significantly affect the adsorption and desorption process and the amount of time needed. They will also show

whether the recycled methyl bromide contains unacceptable impurities.

A portable unit, the Bromosorb™ is ideal for space or soil fumigation. The Halozite® adsorbent is maintained at ambient pressure and the methyl bromide remains stable indefinitely. This allows the portable Bromosorb™ unit to be moved to the next fumigation location where the adsorbent is regenerated and the methyl bromide can be used.

"If broadly applied, the Bromosorb™ technology can dramatically reduce the amount of damaging methyl bromide being released to the atmosphere, while preserving its use as an important fumigant," says Willis.

Summary of Florida Studies: Possible Chemical Alternatives for Tomatoes

Since the spring of 1994, scientists at the University of Florida have completed 14 studies on potential chemical alternatives to methyl bromide fumigation for tomato production in Florida. USDA's Agricultural Research Service and the Florida Fruit & Vegetable Association collaborated on the research venture.

The studies were done at University of Florida research facilities in Quincy, Bradenton, Gainesville and Immokolee.

"These sites were chosen to reflect regional variation in tomato production practices and were known to be infested with a number of economically important soilborne pests such as nematodes, fungi, bacteria and common weeds," says Joseph W. Noling. He is a nematologist at the Citrus Research and Education Center in Lake Alfred.

Alternative fumigant treatments evaluated included Enzone, Vapam (metam sodium), chloropicrin, Basamid (dazomet), Telone C-17 and methyl bromide in different concentrations.

"After we compared initial results obtained in 1994 from the four experimental sites, we knew that a separate, but complementary, herbicide treatment would have to be added to all of the fumigants we were evaluating if we wanted to control weeds and maintain tomato yields," Noling explains. "For all succeeding trials, we included 4 pounds of active ingredient per acre of the herbicide Tillam (Pebulate)."

According to Noling, the results of the 14 studies indicate that none of the alternatives came up to the overall performance of methyl bromide. Telone C-17, combined with Tillam, came closest to methyl bromide in maintaining yields and controlling nematodes and weeds. None of the alternative fumigants, when applied without Tillam, controlled yellow or purple nutsedge, one of the most troublesome weeds for Florida tomato growers.

"We need to be careful not to apply these results to any other crop production system where we now use methyl bromide. For example, using Tillam on Florida pepper has in some cases caused severe phytotoxicity," Noling cautions. "Additional research is needed to find a suitable alternative herbicide for crops that can't tolerate Tillam."

Since most of the studies did not reflect situations of high disease severity, Noling says, some may need to be reexamined. "Also, since all of the tested alternative chemicals require a longer period to break down in the soil, delays will occur in planting crops. Growers will need to be aware of the possibility of crop phytotoxicity and subsequent yield losses."

After only one trial, Enzone was dropped from the experiment because of poor yields, phytotoxic plant responses, low pest control and higher costs due to double-drip line delivery.

The Florida experiments also confirmed dazomet to be inferior in controlling nematodes, compared with other alternative chemicals like Telone C-17. "Under dazomet and metam sodium treatments, root gall ratings in most cases were no different from the untreated control. We applied dazomet at a 400-pound broadcast rate, which is considerably less than the maximum rate labeled for other crops. Because of its high cost and poor performance, we didn't think it prudent or economically viable to consider increasing application rates any further," Noling says. "Also, there were other treatments to explore that had higher efficacy at a lower cost." Dazomet is not currently registered for use on food crops in the United States.

Results from the 14 experiments identified Telone C-17 as the next best alternative to methyl bromide. With high pest pressures, all of the chemical alternatives tested—except Telone C-17 and chloropicrin combined with Tillam—resulted in considerably lower yields than those of the methyl bromide standard.

Telone C-17 also demonstrated excellent control of nematodes. Compared to chloropicrin, Telone C-17 (with Tillam) controlled nutsedge better and produced yields closer to those with methyl bromide, over a broad range of soilborne pest pressures.

But Telone C-17 is not without its problems. Noling comments that California cancelled its use in 1990 because of potential human health and safety concerns. Traces of Telone have been found in groundwater. However, after considerable field research, in 1994, California restored registration and use of Telone under limited acreage and strict enforcement of new application procedures.

"We recognize that Telone C-17, like methyl bromide, is not immune from environmental problems and future

regulatory action which may affect its use in agriculture," Noling says. "Recent action by the U.S. Environmental Protection Agency ensures that the manufacturer of Telone will likely have to reduce maximum application rates on the label, limit geographical areas of use, and significantly increase requirements for personal protective safety equipment for field workers."

In addition to concerns like planting delays, potential phytotoxicity, cost, and possible corrosion of storage containers, there is the issue of commercial availability. DowElanco, the manufacturer of Telone, does not have the facilities to produce enough of the chemical to supply the potential demand of the agricultural community should the chemical be broadly adopted for use on an extensive scale. "The development of any new chemical alternative to methyl bromide, especially one that will be extensively used, is likely to raise new and unexpected questions and problems that must be addressed before the alternative can be implemented," Noling comments.

TECHNICAL REPORTS

Summary of 1995-96 Large-Scale Field Demonstration/Validation Plots for Soil Solarization

Principal Investigator: D.O. Chellemi, University of Florida, North Florida Research and Education Center, Quincy, FL 32351, now with the ARS-U.S. Horticultural Research Laboratory, Orlando, FL 32803.
Cooperators: S.M. Olson, R. McSorley, J.R. Rich, K.D. Shuler, L.E. Datnoff, and K.L. Pernezny

Florida fresh-market tomato producers account for 17 percent of all methyl bromide use in the United States. In an effort to develop an integrated pest management program (IPM) for soilborne pests of fresh-market tomato, we investigated the potential contribution of soil solarization in laboratory, greenhouse and field experiments. The experimens were validated in large-scale demonstration plots on six commodities at nine different commercial farms.

Due to differences in fertilizer applications, inadequate coverage of paint during termination of the solarization period, or failure to collect complete yield data, a direct yield comparison between soil solarization and methyl bromide treated plots was made on three of seven farms with fresh market tomato. On one farm, solarization out-yielded methyl bromide-treated plots by 122 boxes per acre. On the other two farms, methyl bromide out-yielded soil solarization plots, but by less than 100 boxes per acre. In the location where pepper was evaluated, grower packout data indicated that methyl bromide out-yielded soil solarization plots by 78 boxes per acre.

Weed suppression in soil solarization plots was comparable to plots treated with methyl bromide in all locations except when purslane (*Portulaca oleracea* L) and Texas panicum (*Panicum texanum* Buckl.) were present. In these cases, soil solarization failed to provide adequate control. At low levels of disease, soil solarization provided better control of southern blight (*Sclerotium rolfsii*) than methyl bromide (Maxwell/ Suber). Root gall ratings of root systems indicated that soil solarization did not provide adequate control of root-knot nematodes (*Meloidogyne* spp.). Combining solarization with reduced rates of Telone C-17 provided reductions in root galling similar to those achieved with methyl bromide. In general, it appeared that the longer the solarization period, the more effective the suppression of soilborne pests. Soil moisture at or near field capacity was also essential for effective suppression of soilborne pests.

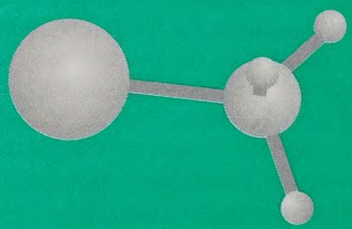
Two technical problems which became evident during the large-scale applications were: (1) If drip irrigation tubing is used, it must be covered with soil to keep the tube from melting. (2) While painting the plastic white to terminate the solarization period, growers must make certain that coverage is uniform and complete to prevent any additional solar radiation from penetrating the plastic and heating the soil to levels detrimental to the health of transplants.

In a followup survey of participants evaluating the performance of soil solarization, growers indicated that soil solarization has a future role in their production system. When asked what extent of their total acreage could utilize soil solarization, the response varied from undecided to 50 percent.

In conclusion, soil solarization appears to be a viable alternative to preplant fumigation with methyl bromide for fall-cropped fresh market vegetables in Florida. However, soil solarization has specific application requirements and limitations which will restrict its widespread application. Fields must be prepared and plastic applied seven or eight weeks before planting. Soil moisture requirements are more stringent than those required for fumigation with methyl bromide. Soil solarization alone does not provide effective control of plant parasitic nematodes and when used in a nematode-infested field, should be combined with an effective nematicide. Suppression of weeds to the point of eliminating their effect on yield is adequate in most situations, but it should be pointed out that weed growth beneath the plastic mulch is not eliminated.

Finally, we highly recommend that soil solarization be used within the context of an IPM program for soilborne pests which includes the coordinated use of multiple pest management tactics based on scouting reports of prior pest levels.

Adoption of this approach will require additional management of information and decisionmaking by the grower.



Upcoming Meetings

Windsor, Ontario, Canada —May 19-26, 1997
Ontario is hosting the International Scientific Conference, Greenhouse Grower Convention and Trade Show, May 19-26, at the Cleary International Center and Windsor Hilton Hotel in Windsor. Called "Growing Media and Hydroponics," this year's meeting will feature Cees Sonneveld from the Netherlands, Merle Jensen, USA, and Peter Adams, UK, along with 44 more invited speakers from 18 countries.

For more information, contact Tom Papadopoulos, Greenhouse and Processing Crops Research Center, Agriculture and Agri-Food Canada, Harrow, Ontario, NOR 1GO; phone: 519-738-2251, ext. 423; fax: 519-738-2929; e-mail, papadopoulost@em.agr.ca; website, <http://res.agr.ca/harrow/circ09.htm>.

Monterey, California —June 10-12, 1997
The Methyl Bromide Global Coalition is sponsoring the 1997 Methyl Bromide State of the Science Workshop, June 10-12, at the Double Tree Hotel, Two Portola Plaza in Monterey, CA.

Purpose is to update scientific knowledge on the role of bromine and methyl bromide in stratospheric ozone loss, identify remaining uncertainties, and discuss possible future research. The workshop will be presented in five sessions: Atmospheric Measurements, Sources and Sinks, Laboratory Kinetics, Modeling, and Open Discussion.

For additional information, contact Bobbie McCallum, Methyl Bromide Global Coalition, P.O. Box 57, Hollister, CA 95024; Overnight delivery address, 8770 Highway 25, Hollister, CA 95023; phone: 408-637-0195; fax: 408-637-0273.

San Diego, California —November 3-5, 1997
Mark your calendar for the 1997 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reduction, to be held November 3-5 in San Diego. Scientists from around the world will present new research information and updates on promising alternatives to methyl bromide. More information will be available soon from Methyl Bromide Alternatives Outreach (MBAO). A call for papers will be issued shortly.

For additional information call MBAO at 209-244-4710.